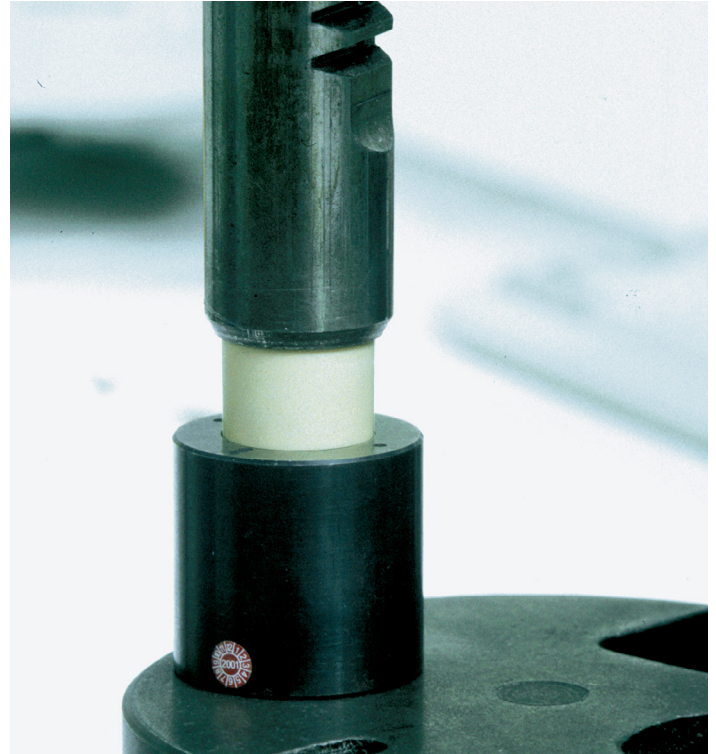


How to properly secure bearings

If the housing is not to their liking, plastic bearings do not hesitate to move out of their mounting holes. In this three-part series, we'll cover why that happens and how to prevent it, how to secure bearings axially, and why the anti-rotational feature is necessary.

Part One: Why do bearings move out?

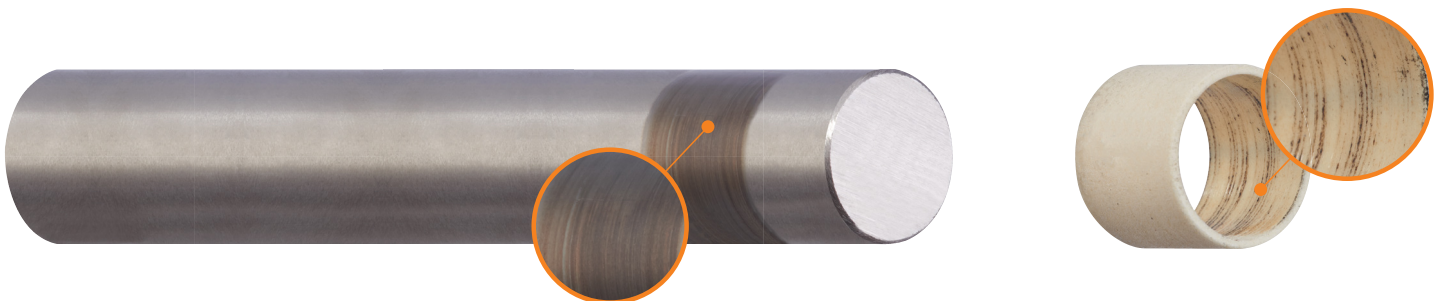
Bearings will move out of the housing if the press fit is lost and there is no additional axial securing. Typically, plain bearings are installed with an arbor press. The holes they are fit into are slightly smaller than the outer diameter of the plain bearings. Therefore, the bearing is kept in place and secured by mechanical tension. If this tension is lower than the push out force generated by the load and movement of the pivot point, the bearing moves out of the mounting hole. The result: a metal shaft scraping away at a metal housing—and a plastic plain bearing torn to pieces.



arbor press used to press-fit a plain bearing during installation

Two reasons for loss of press-fit are high temperatures and high loads. If the temperature in the bearing position rises above the material specific threshold, the material begins to loosen, as it cannot maintain the mechanical tension. The other root cause for losing press-fit is an overly high load that stays over prolonged periods. This is also a material-specific value and describes a concept called “creeping,” which is a slow process of deformation where the material starts to give in to the load. This deformation can also lead to loss of press fit and bearings moving out.

Another more inconsequential (but actually more frequently encountered) issue can be the housing bore being out of tolerance. In that case, if the press fit is too loose due to an oversized housing bore, it can be even more likely that the bearing will move out.



The consequence

Bearings that move in the housing bore do not automatically fall out of it completely. If they cannot move axially, they can still rotate. This can lead to squeaking and decreased overall running performance. The worst case is, of course, a bearing that exits the housing completely, as it leaves the shaft unprotected and results in significant wear.

High temperatures or loads will not always lead to system failures of epic proportions. The specific load-to-surface ratios and temperatures requiring specific materials or additional axial securing vary based on the plastic material and compound.



High speed rotation caused overheating, which led to lost press fit and the bearing rotating in the housing instead of the shaft. Dust originates from the housing and bearing material.

What to do besides selecting the right material?

To make life a bit easier, some manufacturers of plastic plain bearings will provide recommendations for how much surface load a bearing can take, as well as the appropriate temperature range to ensure bearings stay in place.

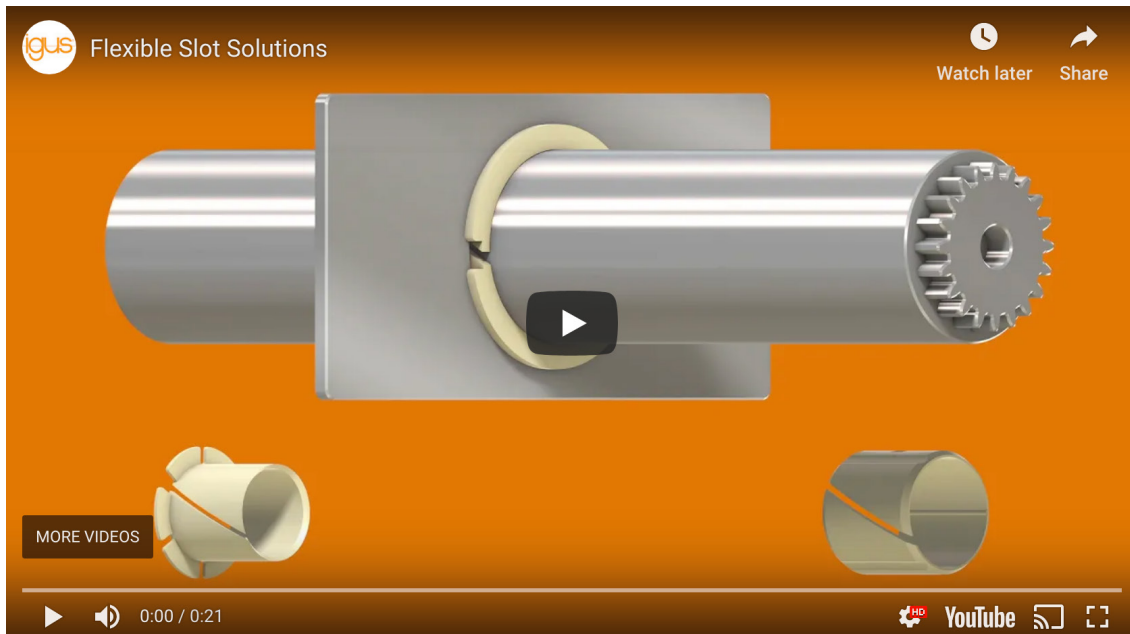
The wrap-up:

Careful material selection and strategic design are vital for securing bearings against moving out of housing bores. Different design choices for securing bearings are covered in **part two** of this series.

Part Two: Axial securing

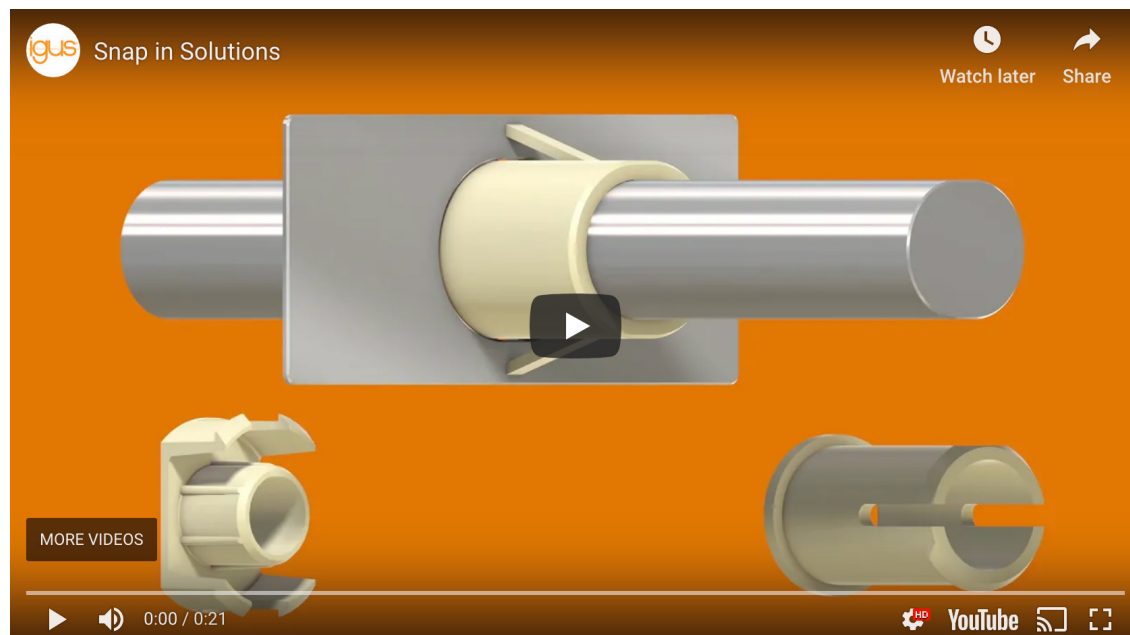
Option 1: Axial securing with slit bearings and undercuts

With an open slit design, the bearing can compensate for a certain range of tolerance deviation from the housing bore. This design also allows for a double flanged shape. The two flanges allow for axial securing in both directions. With the slit design, the bearing can be compressed, allowing the second flange to be put through the mounting hole. Once put in, the bearing expands again so the second flange can keep the bearing from falling out of the housing. As one can imagine, this design also requires the bearing material to be flexible enough to withstand the installation process.



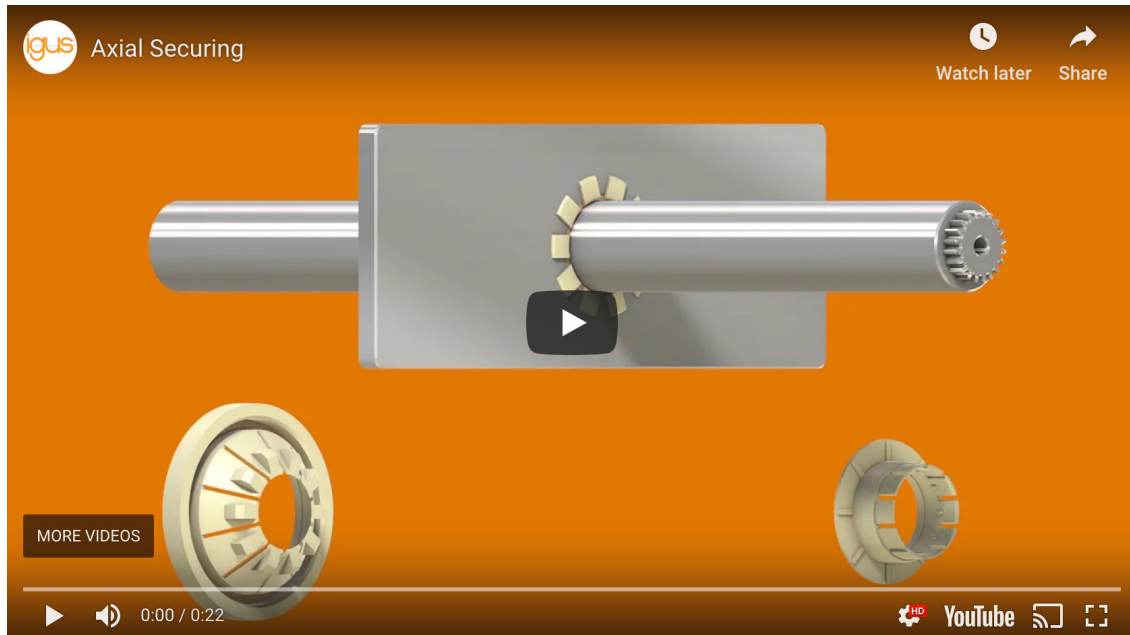
Option 2: Axial securing bearings with “snap-in” solutions

Snap features can help secure bearings axially. During assembly, the protruding undercut features are pressed together automatically. As soon as they pass the assembly hole, they snap back in place and keep the bearing from going back. The flange at the back end of the bearing further prevents the bearing from going in too far. The process is easy, reliable and fast, ideal for use in mass production.



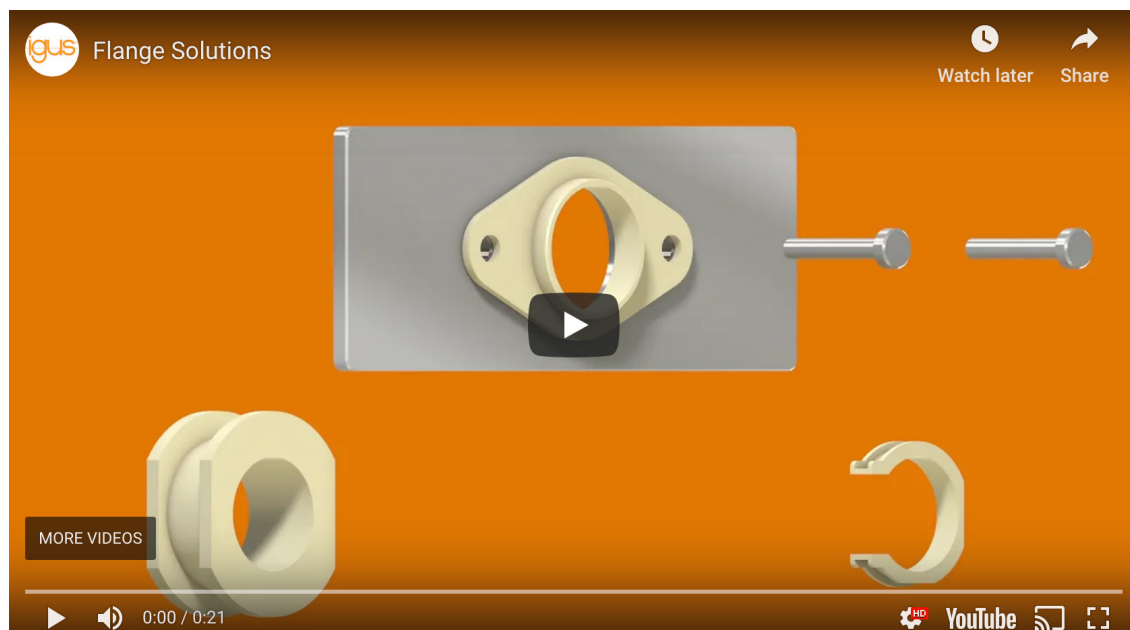
Option 3: Axial securing with flexible, double flange bearings

The use of flexible double flanged bearings is a more advanced way of axial securing and is mainly used in the automotive industry. These bearings offer a special flexible flange. Initially, the bearing only has a flange on one side. The opposite side consists of a number of radially-placed slits. After the bearing is pushed through the mounting hole, another pushing device applies pressure from the opposite side of the mounting hole. During this process, the slit features bend outwards, forming a flange. The bearing then sits tightly secured in the mounting hole.



Option 4: Axial securing with screws – “bullet-proof”

If all else fails, a flange with holes for screws can be used. Users can simply put screws in after the assembly and the bearing will be secured. This is not practical for automated assembly, but it gets the job done.



Option 5: Gluing the part into the housing

Although it is not always the cheapest or fastest method for axially fixing the bearing, there is the option of using an industrial glue. Each bearing material will react differently to the glue, so it is important to contact the bearing supplier for suggestions. This process is especially useful when there may not be time or money for a custom shape or a new tool.

Virtually limitless design choices with plastic bearings

Self-lubricating plastics offer almost unlimited design potential. They can be molded or bent into almost any shape, and are easy to cut or machine. By using modern production technologies like 3D-printing, laser-sintering or injection-molding, it is easier than ever to make design ideas a reality. Metal bearings can be made in many different shapes, but the processes involved are often considerably more expensive, and their design is limited by the necessity of external lubrication.

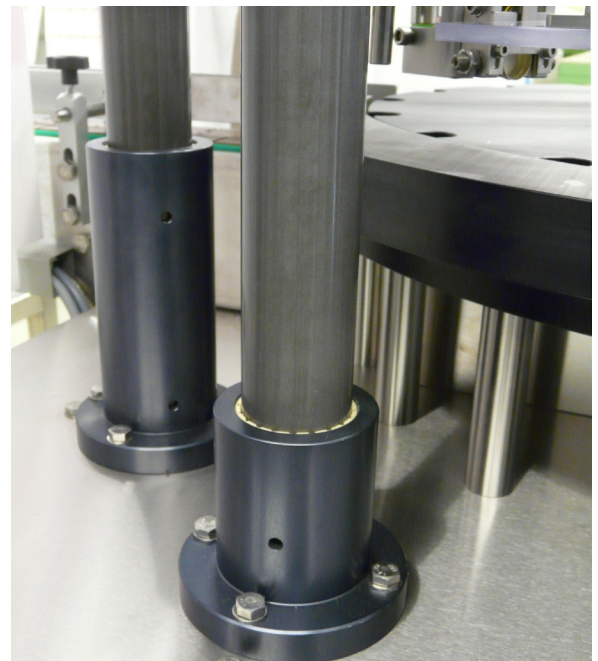
Plastics, especially tribologically-optimized plastics (optimized for low wear and friction) offer a homogenous structure. They are comprised of a mixture of solid lubricants, fibers, filaments and base polymers. Therefore, every surface of a plastic bearing can serve as sliding area.

Part Three: Anti-rotational features

Why would an anti-rotational feature be needed?

In a plain bearing system, the press-fit in the housing hole keeps the bearing in place. The bearing supports the moving shaft, and the low coefficient of friction on the inner diameter of the plain bearing allows the shaft to easily rotate. Since the plain bearing is usually much less expensive than the shaft, it is designed to be a wear part. This means the plain bearing just needs to be replaced every so often, and not the more expensive shaft.

Many metal plain bearings are lined with a thin PTFE layer on the inner diameter. The metal outer layer serves as the backbone of the bearing, while the PTFE layer keeps the shaft running smoothly. Plastic bearings, however, are more flexible. They offer sliding capabilities on both inner and outside diameter. In theory, it does not matter if the shaft rotates inside or if the bearing itself turns in the housing.



Keep things spinning

It is significant if the plain bearing rotates around the shaft in the housing, or if the bearing remains still and the shaft turns inside of it. Typically, shafts are optimized for sliding. Housing holes are not. The machining quality of housing holes is often quite cheap. They are simple holes drilled into a piece of metal, stamped or cut by lasers. Creating holes with a smooth inner diameter is expensive, and the surrounding material of the hole is usually a cheap construction steel or sheet metal. All these circumstances are essentially a collection of nonstarters for wear or sliding components, which is why the bearing should not turn with the shaft in the housing hole. While the bearing itself will not have a problem running on its outer diameter, the surface it will run on will.

Both sliding surfaces in a bearing system are of equal importance. If the metal sliding surface is too rough and abrasive, the bearing will suffer from highly increased wear, resulting in more frequent downtimes or even damage to the bearing system. This is why a classic press-fit, non-rotating plain bearing with a rotating shaft inside is ideal. It is also why alternative methods should be prepared, if a press-fit cannot be maintained.

Free design choices with plastic bearings

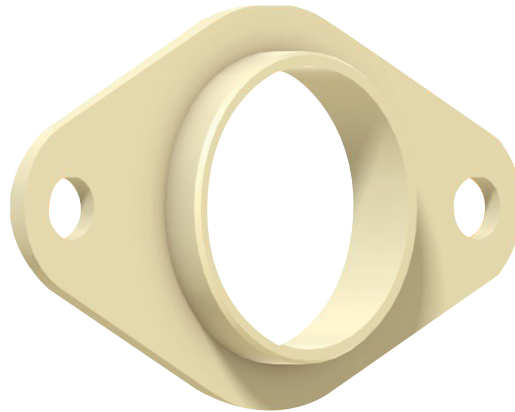
Plastic plain bearings can be made in almost any shape or form. The limitations of metal/bronze/PTFE bearings, such as sheet metal thicknesses or the necessity of lubrication grooves do not exist. Furthermore, manufacturing technologies like injection-molding, 3D printing, sintering and machining of barstock materials allow users to design with few limitations.

Here are some options of how to achieve anti-rotation features:

Careful material selection and strategic design are vital for securing bearings against moving out of housing bores. Different design choices for securing bearings are covered in part two of this series.

Option 1: Anti-rotation with holes in the flange

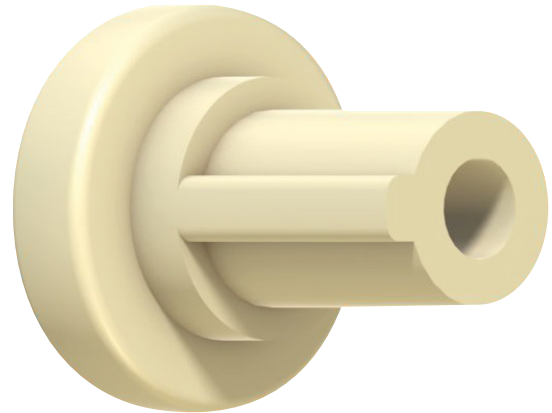
By drilling holes in the flange (or implementing them in the injection mold), the simple holes can serve as an anti-rotation feature. Screws are simply put inside to fix the bearing to the housing. For higher quantities, this design is not the best, since assembly requires manual labor and is therefore more time consuming. On top of that, the costs for screws for each bearing need to be factored in.



Bearing with fixation holes in the flange

Option 2: Anti-rotation features with simple form-fit on the outer diameter

Simple, reliable and cost-effective measures can be taken to keep bearings in place. Form-fit means that the bearing shape itself serves as an anti-rotation feature. This can be achieved by changing the round outer shape of a bearing into something with an edge, or any other protruding feature. The cost increase for an according injection mold is relatively low. It should be considered, however, that a corresponding shape in the housing hole will be needed. For automated assembly, it may be necessary to make sure the bearings are always properly aligned with the housing hole.



Form-fit anti-rotation feature on the outer diameter



Form-fit anti-rotation feature with pin on flange



Custom square design with protruding feature on flange

Option 3: Machining and treatment of the housing hole

Even though machining/treatment has been covered, it should be mentioned again as a feasible option for anti-rotation. Sometimes it can be cheaper to inspect the housing hole and make sure it is properly tolerated. Typically, a regular H7 tolerated bore is enough. To increase press-fit even further, the surface roughness of the hole can be intensified, or its size can be decreased. Users should be aware, though, that tighter press-fits can lead to creeping in the material from mechanical tension, resulting in less press-fit over time.

It does not always have to be tailor-made

In the end, solutions do not always have to be custom-made, which usually comes with added costs for custom injection molds or setup costs. Some bearing manufacturers, like igus®, already have solutions readily available in their catalogs. These are typically available from stock, and CAD-models can be downloaded to fit them in designs more easily. This way, purchasing costs and costs for development and design work can be cut.

There are countless ways to keep plain bearings from moving out or spinning out of control. It depends on the application and environment to determine which solution is best. If further assistance is needed, feel free to [contact an expert](#).